REMARKS

Claims 1-44 were pending in the current application, of which claims 17, 20, and 35-38 are withdrawn. Claims 1-16, 18-19, 21-34, and 39-44 are rejected in the current Office Action (mailed December 30, 2008. Applicant respectfully traverses the rejections and requests that the rejections be withdrawn in light of the amendments and following remarks presented herein.

Amendments

Claims 1, 21, and 24 are amended herein, claims 22-23 are canceled without prejudice, and new claims 45-52 are added. No new matter is added by the amendments or newly added claims, as support for the added limitations can be found throughout the specification, *see e.g.,* paragraphs 0008 and 0019-0025 of the specification.

Rejection Under 35 U.S.C. § 102

Claims 1-8 and 21-26 are rejected under 35 U.S.C. 102(e) as being unpatentable over U.S. Patent 6,894,670 as to Funakoshi et al. (hereinafter "*Funakoshi*"). Applicant respectfully submits that *Funakoshi* fails to anticipate claims 1-8 and 21-26 under 35 U.S.C. 102(e) because *Funakoshi* fails to teach all limitations of those claims.

Discussion of *Funakoshi*

Before addressing the individual claims 1-8 and 21-26, Applicant briefly addresses the disclosure of *Funakoshi*. *Funakoshi* is directed generally to "a method and apparatus for increasing the number of gray levels in a LCD." Col. 1, lines 8-9. Much of *Funakoshi* is directed to use of a monochrome liquid crystal display, *see e.g.,* col. 2, line 47 – col. 3, line 21, and the discussion of Figure 1, particularly col. 6, lines 18-26. In the system proposed by *Funakoshi*, one pixel is represented by a plurality of sub-pixels, and the LCD has a memory for storing information about an offset. The offset is used for converting gray level coordinates of a gamma characteristic spaced evenly, according to the number of bits used for driving a LCD driver, into gray level coordinates spaced unevenly. A gray level adjustment portion uses the offset data to calculate an adjustment to the sub-pixels, and a pseudo-gray-level-expansion portion applies pseudo gray level expansion to the sub-pixel data calculated

by the gray level adjustment portion for display on the LCD. *See* col. 2, line 47 – col. 3, line 5.

Funakoshi introduces its proposed system in Figure 1, and explains that the LCD employed is a monochrome TFT-LCD monitor, *see* col. 6, lines 18-26. Figure 2 is then discussed to expand on the embodiment of Figure 1 (which employs a monochrome TFT-LCD monitor). *Funakoshi* explains with its Figure 2 that there is a gray level adjustment portion (41) and a pseudo-gray-level-expansion portion (42), *see* col. 6, lines 27-31. There is also memory (22) that contains a first offset table (43) for storing an offset for a first sub-pixel and a third offset table (44) for storing an offset for a third sub-pixel, *see* col. 6, lines 31-35.

In operation of the embodiment of Figure 2, the gray level adjustment portion (41) "receives sub-pixel data, which is an 8-bit gray level, corresponding to the first, second, and third sub-pixels from the PC or WS system", and "applies a 10-bit precision offset to the first and third sub-pixels by referencing the first offset table 43 and the third offset table 44 contained in the memory 22." Col. 6, lines 35-42. "That is, offset values are stored in the form of a look-up table for each sub-pixel in the memory 22 which are added to or subtracted from each gray level value as a desired gamma". Col. 6, lines 42-46. Figure 4 of *Funakoshi* is described as showing the gamma curve for each sub-pixel. "Because the brightness levels of 256 gray levels of each sub-pixel are based on different gammas (gamma curves), it is ensured that no integer multiple of brightness level of any gray level (in the range 1-255) at any sub-pixel is identical to brightness level of any gray level (in the range 1-255) at any sub-pixel." Col. 7, lines 18-23.

The pseudo-gray-level-expansion portion (42) applies dithering or frame rate control (FRC) to the 10-bit sub-pixel data to which an offset is applied to convert it into expanded 8-bit data equivalent to more-than-eight-bit data, thereby allowing the data to be transferred to the LCD panel drivers supporting 8 bits. *See* col. 6, lines 30-31, 50-59.

Thus, as discussed at col. 8, lines 36-60 of *Funakoshi*, the gray level adjustment portion (41) looks up an offset value from the offset tables, and applies (e.g., adds or subtracts) the looked-up 10-bit precision offset to an input 8-bit sub-pixel data. The result of that calculation is 10-bit sub-pixel data that is converted to 8-bit data by the pseudo-gray-

level-expansion portion's (42) application of dithering or frame rate control (FRC) to the 10-bit sub-pixel data.

In discussing its Figure 7 at col. 9, lines 19-63, *Funakoshi* mentions that while all of its previous Figures have been described with respect to a monochrome TFT LCD monitor, the approach may likewise be employed "for dramatically increasing the number of colors of a color LCD panel by applying the approach to the color LCD panel" (col. 9, lines 23-26). In doing so, *Funakoshi* explains that "each of the R, G, B sub-pixels constituting one pixel is further divided into two sub-pixels and different gammas are applied to the two sub-pixels." Col. 9, lines 32-34. Again, offset tables are employed, such as a R offset table, G offset table, and B offset table, which each contain 10-bit precision offset values for the R, G, and B gammas, respectively. The adjustment portion (41) is then employed to look up the offset values and calculate the 10-bit sub-pixel values, and the pseudo-gray-level-expansion portion (42) converts the 10-bit data into 8-bit data (again, using dithering or FRC). "As a result, the number of gray levels of each color can be increased and therefore the number of colors can be increased." Col. 9, lines 61-63.

Accordingly, when applied to a color display, *Funakoshi* appears to propose utilizing its technique to increase the number of colors displayable on the LCD, rather than to increase the number of gray levels that may be displayed for a pixel. That is, in *Funakoshi's* application to a color display, each of the R, G, and B sub-pixels are divided into two sub-pixel portions, and the predefined offset values (stored to the R,G,B offset tables) are used to offset one of the two sub-pixel portions by a 10-bit precision value for each of the R,G,B sub-pixel portions. This is taught as increasing the number of colors, rather than being employed to increase the number of perceivable gray levels that may be achieved at a pixel by a combination of the R,G,B values.

Further, in both the monochrome and the R,G,B implementations proposed by *Funakoshi*, predefined offset values (stored to the offset tables) are employed for offsetting sub-pixel portions based on predefined curves, such as shown in Figure 4 of *Funakoshi*.

Independent Claim 1

Claim 1, as amended herein, recites:

> A method for providing pseudo gray levels between true gray levels on a color display, said method comprising:
> determining a number of said true gray levels natively supported by said color display, wherein said true gray levels each correspond to all color drive settings for a pixel being equal value;
> determining an increased number of gray levels desired to be available for display on said color display, wherein said increased number of gray levels includes said true gray levels and said pseudo gray levels, and wherein said increased number of gray levels is a multiple of said number of true gray levels natively supported by said color display;
> receiving a number that identifies a level of said increased number of gray levels to be displayed at a select pixel;
> dividing said received number by said multiple to compute a quotient;
> selecting a true gray level of said true gray levels for the select pixel, said true gray level having each color drive setting for said pixel being equal to said quotient; and
> based on a remainder value obtained from said dividing, adjusting one or more of said color drive settings of said select pixel to set the select pixel to one of the pseudo gray levels, wherein said pseudo gray level will be perceived as falling between two of said true gray levels. (Emphasis added).

Funakoshi fails to teach at least the above-emphasized limitations of claim 1. First, as discussed above, in its implementation that uses a color display, *Funakoshi* proposes a technique for increasing a number of colors, rather than "adjusting one or more of said color drive settings of said select pixel to set the select pixel to one of the pseudo gray levels, wherein said pseudo gray level will be perceived as falling between two of said true gray levels", as recited by claim 1.

In addition, *Funakoshi* does not teach dividing a received number (that identifies a level of an increased number of gray levels to be displayed at a pixel) by a multiple (the multiple that the increased number of gray levels is to the number of true gray levels natively supported by a color display), as recited by claim 1. Further, *Funakoshi* does not adjust one or more of the color drive settings of a pixel based on a remainder value obtained from such dividing, as recited by claim 1. Instead, *Funakoshi* proposes to look-up predefined offset values from a table, which are then applied (added or subtracted) to a corresponding sub-pixel. Because the offset value is a 10-bit precision value offset, this application results in a

10-bit value, which is then converted into 8-bit data for display. No dividing or adjusting based on a remainder of the dividing operation, as recited in claim 1, is disclosed by *Funakoshi*.

For at least the above reasons, independent claim 1 is not anticipated by *Funakoshi*, and therefore Applicant respectfully requests that the outstanding rejection be withdrawn and claim 1 be passed to allowance.

Independent Claim 21

Independent claim 21, as amended herein, recites:

> A method of enhancing gray scales on a color display, wherein a plurality of color drive settings are used for outputting a pixel, said method comprising:
>
> capturing an image to be represented as multiple shades of gray; and
>
> mapping said multiple shades of gray of said image to provide a depth of gray levels for a pixel beyond what is available in true gray scale on said color display, wherein said true gray scale comprises a plurality of gray levels that each correspond to all of said color drive settings for said pixel being equal value, and wherein said mapping comprises:
>
> determining a number of gray levels in said true gray scale;
>
> determining an increased number of gray levels desired to be available for display on said color display to provide said depth, wherein said increased number of gray levels includes said gray levels of said true gray scale and pseudo gray levels that are perceivable as falling between two levels of said true gray scale;
>
> receiving, for said pixel in said image, a number that identifies a level of said increased number of gray levels to be displayed at said pixel;
>
> dividing said received number by a ratio of said increased number of gray levels to said number of gray levels in said true gray scale to compute a quotient;
>
> selecting a gray level of said true gray scale for the pixel, said selected gray level having each of said plurality of color drive settings for said pixel being equal to said quotient; and
>
> based on a remainder value obtained from said dividing, adjusting one or more of said color drive settings of said pixel to set the select pixel to one of the pseudo gray levels. (Emphasis added).

For reasons similar to those discussed above with claim 1, *Funakoshi* fails to teach at least the above-emphasized limitations of claim 21. Therefore, independent claim 21 is not anticipated by *Funakoshi*, and thus Applicant respectfully requests that the outstanding rejection be withdrawn and claim 21 be passed to allowance.

Dependent Claims 2-8 and 24-26

Dependent claims 2-8 and 24-26 each depend either directly or indirectly from one of independent claims 1 and 21, and thus inherit the limitations of their respective independent claim. As such, claims 2-8 and 24-26 are likewise believed to be of patentable merit over *Funakoshi* for at least the reasons discussed above with claims 1 and 21.

Rejection Under 35 U.S.C. § 103

A. Claims 9-16, 18, 19, and 39-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant Admitted Prior Art (hereinafter "*AAPA*") in view of U.S. Patent 6,714,206 as to Martin et al. (hereinafter "*Martin*"). To establish prima facie obviousness of a claimed invention, all the claim limitations must be shown by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). As discussed below, the applied combination fails to teach or suggest all limitations of the claims.

Independent Claim 9

As discussed in Applicant's previous response, *Martin* fails to disclose all limitations of independent claim 9. In particular, claim 9 recites in part "adjusting said displayable gray scale number based on a remainder obtained from said dividing", and *Martin* is not able to adjust the displayable gray scale number. *Martin* merely places groups of pixels, having different values on the set gray scale, adjacent to each other on the display to give a perception of a different gray color.

The current Office Action contends that *Martin* discloses "adjusting said displayable gray scale number based on a remainder obtained from said dividing", citing to fig. 13, col. 1, lines 40-53, col. 4, lines 5-17, and col. 8, lines 14-54 of *Martin*, *see* page 6 of the Office Action. Applicant respectfully disagrees. The cited portions of *Martin* describe the use of temporal dithering that occurs over 4 frames, *see* col. 8, lines 21-26. This divides the current fame number by the number frames over which the temporal dithering occurs (i.e., 4 in this example). When the remainder of this division is 2, the sub-pixels with an odd frame number are adjusted when the current frame number is odd, and the sub-pixels with an even frame number are adjusted when the current frame number is even. Thus, a different 2 out of 4 sub-

pixels are adjusted from one frame to the next. *See Martin's* discussion of Figure 13 at col. 8, lines 14-54.

Thus, this disclosure of *Martin* proposes to employ dividing of a current frame number by the number of frames over which temporal dithering occurs in order to adjust different sub-pixels each from one frame to the next. This fails to teach or suggest "adjusting said displayable gray scale number based on a remainder obtained from said dividing" for reasons similar to those discussed in Applicant's previous response.

Similarly, *AAPA* fails to teach or suggest any such adjusting said displayable gray scale number based on a remainder obtained from said dividing. Instead, as the *AAPA* specifically notes with reference to Figure 1 in the present application, a 6-bit implementation of a color display is limited to only 64 true gray levels (including Black and White).

Accordingly, the combination of *AAPA* and *Martin* fails to teach or suggest all limitations of independent claim 9. Therefore, the rejection of claim 9 should be withdrawn, and claim 9 should be passed to allowance.

Independent Claim 39

Independent claim 39 recites "adjusting said displayable gray scale number based on a remainder obtained from said dividing." Thus, for reasons discussed in Applicant's previous response and further discussed above with claim 9, the combination of *AAPA* and *Martin* fails to teach or suggest at least this limitation of claim 39. Therefore, the rejection of claim 39 should be withdrawn, and claim 39 should be passed to allowance.

Dependent Claims 10-16, 18, 19, and 40-44

Dependent claims 10-16, 18, 19, and 40-44 each depend either directly or indirectly from one of independent claims 9 and 39, and thus inherit the limitations of their respective independent claim. As such, claims 10-16, 18, 19, and 40-44 are likewise believed to be of patentable merit over the applied combination of *AAPA* and *Martin* for at least the reasons discussed above with claims 9 and 39.

B. Claims 27-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over *AAPA* in view of Martin and in further view of U.S. Publication No. 2002/0180751 as to Rozzi (hereinafter "*Rozzi*"). To establish prima facie obviousness of a claimed invention, all the claim limitations must be shown by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974). Because the proposed combinations fail to teach multiple claim limitations as asserted by the Examiner, Applicant respectfully submits that the present rejections are improper.

Claim 27 recites "dividing said input number by a factor to obtain a displayable gray scale number, and adjusting color outputs based on a remainder obtained from said dividing." This claim was rejected based on the incorrect interpretation of spatial dithering in *Martin* (as discussed above with claim 9). Accordingly, submits that the rejection of claim 27 is not proper and requests that it be withdrawn.

Claims 28-34 depend either directly or indirectly from independent claim 27, and thus inherit each and every limitation of claim 27. As a result, claims 28-34 are likewise allowable for at least the reasons set forth above for claim 27.

New Claims

New claims 45-52 are added herein. Of these, claims 45 and 49 are independent. Claims 46-48 depend either directly or indirectly from claim 45, and claims 50-52 depend either directly or indirectly from claim 49. Applicant respectfully submits that these claims are also allowable over the applied art of record.

For instance, independent claim 45 recites:

> A method of enhancing gray scale output on a color display, said method comprising:
> determining a number of true gray levels natively supported by said color display, wherein said true gray levels each correspond to all color drive settings for a pixel being equal value;
> determining a desired number of gray levels to be available for display on said color display, wherein said desired number of gray levels is greater than said number of true gray levels natively supported by said color display and wherein said desired number of gray levels is a multiple of said number of true gray levels natively supported by said color display;
> receiving a number that identifies a level of said desired number of

gray levels to be displayed at a select pixel;

dividing said received number by said multiple to compute a quotient, wherein said quotient provides a preliminary value for each of the color drive settings for the select pixel;

based on a remainder obtained from said dividing, determining an adjustment to said preliminary value for at least one of the color drive settings for the select pixel; and

using said color drive settings to output the select pixel on said color display. (Emphasis added).

The applied art of record fails, individually or when considered in combination, to teach or suggest at least the above-emphasized limitations of claim 45.

Claim 49 recites:

A method of enhancing gray scale output on a color display, said method comprising:

determining a number of true gray levels natively supported by said color display, wherein said true gray levels each correspond to all color drive settings for a pixel being equal value;

determining a desired number of gray levels to be available for display on said color display, wherein said desired number of gray levels is greater than said number of true gray levels natively supported by said color display;

receiving a number that identifies a level of said desired number of gray levels to be displayed at a pixel;

dividing said received number by a ratio of said desired number of gray levels to said number of true gray levels natively supported by said color display to compute a quotient, wherein said quotient provides a preliminary value for each of the color drive settings for the select pixel;

when a remainder obtained from said dividing is zero, setting each of the color drive settings to the preliminary value for outputting the select pixel; and

when said remainder obtained from said dividing is non-zero, adjusting said preliminary value for at least one of the color drive settings for outputting the select pixel. (Emphasis added).

The applied art of record fails, individually or when considered in combination, to teach or suggest at least the above-emphasized limitations of claim 49.

CONCLUSION

In view of the above, applicant believes the pending application is in condition for allowance.

Applicant believes a fee in the amount of $752.00 is due with this response. However, if any additional fee is due, or at any time during the pendency of this application, please charge any additional fees required or credit any overpayment to Deposit Account No. 06-2380, under Order No. 65744/P021US/10404749 from which the undersigned is authorized to draw, during the pendency of this Application pursuant to 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees.

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Respectfully submitted,

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